probably adopt a plan which has been extensively employed by Prof. Pickering, but so far has had few imitators. This consists in photographing the trail of a star. If we leave a phototelescope at rest with a plate exposed, the stars describe circular arcs on the plate having the pole as a centre, and having a length of 15° for each hour of exposure. The linear length will vary according as the star is near or remote from the equator, and since the energy is distributed over this varying length, polar stars will produce more intense trails than those stars of equal brightness near the equator. Effectively if two stars are found giving trails of equal density, the brightness of the two stars varies as the cosine of the declination. But if it be found that the stars near the equator travel, by reason of the earth's rotation, so rapidly across the plate that the fainter among them leave no trail, it is possible to give such a rate to the driving clock that the trail may be of any definite length, and the energy concentrated for a longer or shorter time over this space.

The method of deriving the stellar magnitude from an examination or measurement of these trails will be best understood by considering the case of the polar stars. A plate was exposed to the pole for ten minutes, and the telescope left stationary. The aperture was then reduced by successive amounts, so that theoretically any star would appear one magnitude fainter. In the case of a selected star, therefore, we have the thickness of the trail corresponding to known magnitudes, which could at once be compared with the trails formed on other plates. Actually these trails, corresponding, it is presumed, to stars of known magnitudes, were brought into juxtaposition with the trails of stars whose magnitude was sought, and the brilliancy was decided by equality of appearance. Of course similar practices could be and have been pursued when the stars are represented on the plate by means of circular discs. By varying the length of exposure in the photograph of a star of known magnitude, we can approximate to the appearance that stars of any magnitude would present for known durations of exposure. But here difficulties connected with the sensitiveness of the plate, and the meteorological circumstances of the night affecting the transparency of the atmosphere, have to be taken into the account, and the effects eliminated from the observation as carefully as possible, so that it is doubtful if a higher degree of precision results than in the case of photometric observation. There is, however, the obvious advantage that the photographs remain, and greater leisure and further experiment may suggest improved methods of observation and reduction, that shall ultimately give us all the accuracy needed in investigations of this character. The process as at present employed by Prof. Pickering appears to be fairly rapid. Three or four years ago he could report that he had applied his method to over 60,000 images, and the accuracy appears to be about as great as in the case of photometric observations. The chances of systematic error are probably greater.

NOTES.

At Marlborough House, on Tuesday, in the presence of the Council of the Society of Arts, the Prince of Wales presented to Sir Joseph Lister, Bart., the Albert Medal accorded to him by the Society for "The discovery and establishment of the antiseptic method of treating wounds and injuries, by which not only has the art of surgery been greatly promoted and human life saved in all parts of the world, but extensive industries have also been created for the supply of materials required for carrying the treatment into effect."

Prof. Christopher Heath has been elected President of the Royal College of Surgeons, in the place of the late Mr. J. Whitaker Hulke, F.R.S.

Dr. G. S. Buchanan has been appointed to the office of Medical Inspector of the Local Government Board.

The Croonian Lectures at the Royal College of Physicians will be delivered by Dr. W. Marcet, F.R.S., on June 18, 20, 25, and 27, the subject being the "Respiration of Man."

The grants lately made by the United States Congress, for the Geological Survey during the fiscal year 1895–96, amount to 515,000 dollars, or £103,000. This sum includes all field and office expenses and salaries.

Last week, the colleagues and former pupils of Sir William Turner, Professor of Anatomy in the University of Edinburgh, presented him with his portrait, as a mark of appreciation of his services in the cause of science and to the University.

In connection with the Goldsmiths' Company's grant for researches on the anti-toxin treatment, a Committee of the Royal College of Surgeons of England have recommended a grant of one hundred pounds to Dr. Sidney Martin, for the purpose of working out the action of the anti-toxic serum, when used to counteract the effects of various poisons separated by him from the membrane, and from the spleen, in cases of diphtheria.

We have already noted that the London Chamber of Commerce are promoting a Bill for legalising the use of metric weights and measures for export trade purposes. In connection with this, the London County Council has just resolved to do all in its power to secure the passing of the Bill during the present Session. In the meantime the Council's inspectors will not interfere with the use of metric weights and measures in the execution of foreign orders.

Among the men of science who have died during the past week is Theodor Brorsen, whose name is so well known to astronomers. He was born in 1819, and was the discoverer of five comets, as well as the author of a number of writings on astronomical subjects. Since 1879, he lived in retirement at Norburg, his native place. Mr. J. H. Greener, the constructor of several early lines for telegraphic communication, and one of the most able of practical telegraph engineers, died on Sunday, in his sixty-sixth year.

The President of the German Meteorological Society has issued invitations for a general meeting of the Society, to be held at Bremen on the 17th, 18th, and 19th inst., when various matters of interest to meteorologists will be discussed. The time of meeting has been fixed so as to fall in with the geographical conference, which will be held at the same place during Easter week, and in which oceanography and maritime meteorology form a prominent part. The subject of south polar investigation is also included in the geographical programme, so that it is anticipated that a large number of scientific men will take part in the proceedings.

The spring meeting of the Iron and Steel Institute will be held in London on Thursday and Friday, May 9 and 10 next, in the rooms of the Society of Arts. The presidential address will be delivered by Mr. David Dale, and the Bessemer gold medal will be awarded to Mr. H. M. Howe, who will contribute a paper on "The Hardening of Steel." Mr. Stead, of Middlesbrough, will contribute a paper on "The Effect of Arsenic on Steel"; Mr. Sergius Kern, Metallurgist to the Russian Admiralty, will discuss the manufacture of armourpiercing projectiles in that country; Mr. Herbert Scott will communicate a paper on the iron ore mines of Elba; and Mr. W. J. Keep, of Detroit, will contribute a paper on "Tests of Cast Iron."

PROF. DR. G. SCHWEINFURTH, the distinguished African traveller and botanist, has passed the winter at Hélouan, near Cairo, where he is engaged in mapping and describing the adjacent mountains and "wadis," for a memoir to be communicated to the Institut Egyptien. Dr. Schweinfurth has just published the text of an interesting lecture on Erythræa—the Italian colony on the Red Sea—delivered before the Geographical Society of Berlin in July last year. This paper gives an account of a four-months' expedition which he made to Erythræa in the early spring of 1894, in company with Dr. Max Schoeller. It gives a most favourable report of the progress of the new Italian colony and of its future prospects.

A CORRESPONDENT has sent us particulars of an explosion which occurred at Providence, Rhode Island, U.S.A., on March 8, in connection with the electric light mains of that city. The explosion resembles those recently investigated by Major Cardew (see p. 539). Through a leak in the gas mains, the conduits became full of an explosive mixture, which suddenly exploded with great violence. The street was blown up for some thirty feet, all the glass in neighbouring houses wrecked, and missiles of wood and iron thrown to some distance. The noise and shock are said to have been felt all over the city.

THE circumstances connected with the formation of the dangerous alkaline deposits found by Major Cardew on the mains of the St. Pancras electric light supply, and the presence in this deposit in some cases of the alkaline metals in an unoxidised condition, have been inquired into by a Committee of the Royal Society and the Institution of Electrical Engineers, and the results have been issued in a report, which states that "the Committee are of opinion that the explosions which have occurred were caused by the firing of an explosive mixture of coal-gas and air by sparks caused by means of the above-mentioned incrustation. It has been proved that sparks may be caused either by the incrustation itself acting as an imperfect electrical conductor, or by moisture coming into contact with metallic sodium or potassium, both of which metals have been found to exist within the incrustation. These metals have been produced by the electrolytic decomposition of alkaline salts, chiefly derived from the soil and conveyed by moisture along the fibres of the wooden bearers towards the negative conductor. To avoid a repetition of these accidents, the bearers of the insulators at present in use should be replaced by other devices through which moisture is prevented from travelling, and it is recommended that the pattern of insulator in use should be changed, and a pattern adopted in which a longer insulating surface is interposed between the conductors and the bearer. The Committee are also of opinion that it is desirable that means should be provided by which the conduits can be inspected throughout their length, so far as is necessary to detect incrustations on the insulators. The Committee have not thought it within their province to investigate the causes of the presence of coal-gas within the electric lighting conduits, but it is obvious that this is the primary source of danger."

DR. DUPRE's report with reference to the recent explosion of a cylinder filled with compressed oxygen, at Fenchurch Street Station, was read at the coroner's inquiry last Thursday. An examination showed that the inner surface of the cylinder was fairly clean, but at the end on which the valve was, the surface was incrusted with magnetic oxide of iron, which was easily removable, and which under the microscope showed in many places the globular form assumed by the magnetic oxide produced by the burning of iron or steel. The lower end of the brass screw, by means of which the valve fittings were screwed into the bottle, was also incrusted with magnetic oxide of iron, much of which was in the form of small globules produced by fusion at very high temperature. They were evidently fused to the material of the screw, and it in some cases even slightly pitted the metal. These facts lead Dr. Dupré to conclude, first, that the bottle at the time of the accident contained an explosive gaseous mixture; and that, secondly, this mixture was fired by some portions of finely-divided iron, or perhaps grease, igniting in the compressed gas. That some iron had actually been on fire in the cylinder the condition of the screw sufficiently proved. The coroner, in summing up, spoke strongly in favour of a Government test being imposed with regard to the cylinders; and the jury included in their verdict the recommendation that all compressed gases of an explosive nature should be scheduled under the Explosives Act, that all cylinders should be tested by the Government periodically, that no cylinder should be allowed to be used or conveyed about unless bearing the Government stamp, that all manufacturers should be licensed by the Board of Trade in the future, and that separate hydraulic pumps should be used in the apparatus in filling the cylinders, and also recommended a Board of Trade and railway inquiry.

AT the Institution of Civil Engineers, on April 2, Mr. J. I. Thornycroft, F.R.S., and Mr. S. W. Barnaby, in a joint paper, expressed the belief that the speed of vessels had now approached within measurable distance of that at which propulsion by screws became inefficient. For a given pitch-ratio and slip, the thrust per unit of area varies as the square of the speed. Certain conditions of pressure on the screw-blades cause the formation of cavities, filled with air and vapour driven off from the water, behind the blades. Experiments carried out by the authors, with screw-blades of elliptical form, show that this "cavitation" does not commence suddenly, but appears to become detrimental when the mean negative pressure on the forward side of the blades exceeds about $6\frac{3}{4}$ lbs. per square inch, or when the whole thrust exceeds $11\frac{1}{4}$ lbs. per square inch. Cavitation can only be avoided at very high speed by increasing either the immersion of the screw or its blade-area. Immersion is limited by considerations of draught. Increased area, the authors remarked, can be obtained in three ways: (1) by increasing the ratio of surface to disc-area, (2) by employing a larger diameter than that theoretically best for the given conditions, (3) by increasing the pitch-ratio, which involves a larger diameter with a reduced rate of revolution. Either tends to a waste of power if pursued beyond somewhat narrow limits, and it appears inevitable that reduced efficiency must be submitted to as the speed of vessels is increased.

A FEW noteworthy points were brought out last week in evidence before the Select Committee of the House of Commons appointed to consider the advisability of adopting the metrical system of weights and measures. Captain H. R. Sankey, R.E., director of the engineering firm of Willans and Robinson, Thames Ditton, said that the metric system of measurement had been adopted by his firm for the last two years. The reason of the change was the advantage of working interchangeably with manufacturing engineers on the continent. His firm's trade was mainly British, but no objection had been made to metrical measurements by British customers. The workmen were agreed that the metric system was much more easy to work with than the English measures, and was much less liable to error. The inconvenience of the change to the metric system was only felt by the workmen for a few days. In his evidence, Dr. Gladstone estimated that in the elementary schools about 350 hours were occupied in teaching our cumbrous system of weights and measures. As the children had to learn decimals, very little more time would be needed by them for learning the metric system. A chart explaining the metric system was now to be found in nearly all the London schools, and lately it had been decided to supply actual examples of the metre and litre to such schools as asked for them. The metric system was but partially taught in the schools, for the teaching involved additional labour, and was not insisted on by the inspectors. The introduction of the metric system would be much facilitated if the system were compulsory in the elementary schools.

In a paper read before a recent meeting of the Académie des Sciences (*Comptes rendus*, cxx. p. 611), M. Lucien Poincaré described some experiments on secondary batteries he has been performing. With a view of reducing the losses that take place in the ordinary lead accumulator, the author has tried to obtain a battery with *liquid* metallic electrodes. For this purpose mercury has been employed, and as it would not do to employ an acid as the electrolyte, since the hydrogen would be liberated and thus cause a waste of energy, a solution of a salt is used. Under these circumstances an amalgam is formed at the cathode, which, together with the mercury of the anode, forms a secondary cell. Of all the different salts tried, the most interesting results have been obtained with the haloid salts of the alkaline metals. With these salts the electromotive force of the secondary battery is about two volts, but in the case of the chlorides and bromides, the chlorine or bromine combines with the positive mercury, forming a badly-conducting layer, so that the output of the cells is not satisfactory. With a solution of iodide of sodium, however, very satisfactory results are obtained, for as long as the solution is kept sufficiently concentrated, the current density during the charging is not too great, and the positive electrode has a larger surface than the negative electrode, no deposit is formed on the anode. Hence by this arrangement a secondary cell is obtained in which the two electrodes remain, after the charge, entirely metallic, so that the internal resistance does not increase as the cell is charged. The efficiency of these cells amounts to very nearly 90 per cent., the electromotive force, when fully charged, being 1·85 volts. The capacity per kilogram does not differ much from that obtained with ordinary lead accumulators, being about 10 ampere-hours. A very important point about this form of cell is that the density of the *discharge* current is immaterial, and they may be completely discharged without in any way deteriorating.

We have received from Prof. G. Hellmann an interesting pamphlet entitled "Contribution to the Bibliography of Meteorology and Terrestrial Magnetism in the Fifteenth, Sixteenth, and Seventeenth Centuries." The work was prepared for the Report of the Chicago Meteorological Congress, and contains a list and brief bibliographical notes of 272 old books in Dr. Hellmann's library, arranged under the authors' names, with cross references under subjects and dates. This pamphlet is of considerable value to meteorologists, as the early literature of this subject is as yet little known, and no meteorological institute is as rich in the older literature as the library in question. Arranging the books according to the language in which they were written, Dr. Hellmann shows that the authors comparatively seldom employed their native language, as 157 of the works are in Latin. There is also a preponderance of Italian works, as in the seventeenth century Italy probably contributed more to meteorology than all the other nations of Europe. Many of the works described are exceedingly scarce.

Since the great Japanese earthquake of 1855, the strongest shock felt in Tokyo was that of last June 24. No house was absolutely destroyed, but in the lower parts of the city many brick buildings were damaged and chimneys thrown down. The total land-area disturbed was 42,000 square miles. The diagram of the earthquake, taken by a large-motion seismograph at Tokyo, is given by Messrs. Sekiya and Omori in a short but valuable paper (*Journ. of the Coll. of Science*, Imp. Univ., Tokyo, Japan, vol. vii. part v. 1894). This diagram being on the natural scale, the preliminary tremors are not shown, and during the first two seconds of the record the motion was already strong. It then became suddenly violent, the ground moving 37 mm., followed by a counter movement of 73 mm., the maximum horizontal displacement during the earthquake. At about the same time, the maximum vertical motion of 10 mm. occurred. The movement, which lasted altogether 4½ minutes, soon became comparatively weak, and it is no doubt to the small number of violent oscillations that the slight amount of damage is due. As usual, the direction of motion changed during the earthquake, but the maximum horizontal motion was directed towards S. 70° W., and this is identical with the mean direction of overturning of 245 stone lanterns in different parts of Tokyo.

The Natural History Society of Queensland, established in the beginning of 1892, has progressed so well that it is able to issue a volume of *Transactions*. The volume should prove to be a useful contribution to the literature on the natural history of the colony.

The fifteenth volume of observations of "Rainfall in the East Indian Archipelago," published by the Government of Netherlands, India, has been received. The volume is edited by Mr. Van der Stok, the director of the observatory at Batavia, and it comprises observations made at 194 stations, of which 104 are in Java and Madoera, and ninety in Sumatra and the different islands of the Eastern Archipelago.

In the *Geological Magazine* for April appears a translation of a Swedish paper by Prof. Lindström, on the discovery of *Cyathaspis* in the Silurian formation of Gotland. In the cutting of canals for the drainage of marshy tracts of the island, many good exposures have been made of the fossiliferous marl-shales that underlie the famous limestones with the operculate coral *Rhizophyllum*. Among the fossils obtained from these shales were a pair of dorsal shields of a Pteraspidian fish. Hitherto the oldest known indubitable fish-remains date from the Ludlow epoch, but the Gotland beds are of Wenlock age. It is pointed out that since the vertebrate character of the Cambrian conodonts has been disproved, and the supposed Ordovician fish-remains of North America are very doubtfully of that age, these Gotland fossils are, for the present, the oldest known Vertebrates.

First among the new editions received within the past few days is Prof. James Dana's "Manual of Geology," published by the American Book Company. The appearance of this fourth edition of Prof. Dana's classical work, makes us marvel at the energy of the eminent author who, though now eighty-three years of age, could rewrite the whole of the matter in such a ponderous volume as the "Manual," and add one hundred and fifty pages to what was published in the third edition. It is hardly necessary to say that a multitude of new principles, new theories, and new facts, in all branches of geology, have been included in the new edition. "The Partition of Africa" (Stanford), by Mr. J. Scott Keltie, has reached a second edition, after two years of life. The many events that have taken place in Africa during this time are all given consideration. Another volume which has attained the eminence of a second edition is "Outlines of Zoology," by Mr. J. A. Thomson, published by Mr. Y. J. Pentland. The book has evidently been appreciated by students of zoology as a manual for use in the lecture-room, museum, and laboratory. Messrs. W. H. Allen and Co. have published a third and revised edition of "Practical Microscopy," by Mr. G. E. Davis.

The lower sulphide of carbon, CS, appears to have been obtained by Dr. Deninger, of the Dresden Laboratory, in considerable quantities. Anhydrous sodium sulphide and excess of chloroform were heated in sealed tubes, from which the air had previously been removed, to a temperature about 180°. Upon opening the tubes after cooling a large volume of gas was discharged, which consisted of sulphuretted hydrogen, a small quantity of hydrogen chloride, and a new gas, which was practically unaffected by passage through a solution of caustic soda. This gas was combustible, burning with production of sulphur dioxide, and would appear to be carbon monosulphide, produced in accordance with the following equation:

$$3Na_2S + 2CHCl_3 = H_2S + 6NaCl + 2CS.$$

The same gas is obtained, less admixed with impurity, by heating in sealed tubes a mixture of silver sulphide and iodoform, and subsequently allowing the product, consisting of carbon monosulphide and sulphuretted hydrogen, to bubble through caustic soda solution, whereby the latter gas is absorbed.

$$3Ag_2S + 2CHI_3 = H_2S + 6AgI + 2CS.$$

An analysis was made of the gas thus obtained, and the result agreed with the formula CS. The gas explodes violently in the eudiometer, so that analysis is not readily carried out volumetrically; the explosion pipette was destroyed in a second attempt. The action of sodium upon carbon disulphide was next studied. When the metal is placed in the liquid disulphide it becomes coated with a greyish substance, which prevents further action. It was found, however, that aniline dissolves this coating, leaving the metal clean; when carbon disulphide is then added, a continuous evolution of gas occurs, but the greater portion of the gas does not escape, being energetically absorbed by aniline, unless the sodium is maintained at the surface of the liquid. After purification of the gas by passage through caustic soda, and through triethyl phosphine to remove carbon disulphide, it is found to burn with a blue flame, with production of sulphur dioxide and water. The latter is owing to admixture of free hydrogen, which can readily be isolated by absorption of the carbon monosulphide in aniline in a Hempel burette. Carbon monosulphide is also rapidly absorbed by alcohol. Upon allowing the mixture of hydrogen and carbon monosulphide to stream through tubes immersed in a freezing mixture, the latter gas condensed to a clear colourless liquid, which rapidly evaporated upon removal from the freezing mixture. It would thus appear that carbon monosulphide is a gaseous substance at the ordinary temperature, but which readily condenses to a liquid in an ordinary freezing mixture, is combustible, and is energetically absorbed by alcohol and aniline.

The additions to the Zoological Society's Gardens during the past week include a Feline Douracouli (*Nyctipithecus vociferans*) from South Brazil, a Squirrel Monkey (*Chrysothrix sciurea*) from Guiana, presented by Mr. Augusto Lewy; a Ring-necked Parrakeet (*Palæornis torquatus*) from India, presented by Lady Aitchison; two Hybrid Widgeon (between *Mareca penelope*, ♂, and *M. chiloensis*, ♀), bred in England, presented by Mr. J. Charlton Parr; seven Common Skinks (*Scincus officinalis*) from the Sahara Desert, presented by Major Sullivan; a Haast's Apteryx (*Apteryx haasti*), an Auckland Island Duck (*Nesonetta aucklandica*) from New Zealand, nine Hamadryads (*Ophiophagus elaps*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

The Lyrid Meteors.—Mr. Denning draws attention to the fact that this year the Lyrid shower may be observed practically in the absence of the moon. Though rarely forming a striking shower, the stream is astronomically important for the reason that it is probably the only one, besides the Perseids, which has its radiant displaced on successive nights of observation. The duration of the shower is from April 16 to 23, with a maximum on the 20th, and the displacement of the radiant is comparatively small. On April 20, the radiant is situated in R.A. 270°, Decl. + 33°, that is, about 1° N. of 104 Herculis, a star of the 5th magnitude. Like the Perseids of August, the Lyrids never fail to show themselves, though they are rarely to be compared with the Perseids in point of richness (*Observatory*, April). The orbit of the swarm is probably identical with that of Comet I, 1861.

A New Form of Zenith Telescope.—The determination of the zenith distances of stars near the zenith appears likely to be greatly simplified by an arrangement recently devised by M. Louis Fabry (*Bulletin Astronomique*, April). The main idea is to materialise the zenith point so that micrometric measurements can be made directly in the field of view. A horizontal telescope is fixed in the meridian, and in front of it is a thin sheet of glass inclined at 45°; beneath this is a basin of mercury. When adjusted so that the reflected image of the cross-wires is coincident with the wires themselves, the wires mark the zenith point, and stars of sufficient brightness will also be seen in the field of view after transmission through the glass and subsequent reflection from the mercury and glass. The great objection to this simple plan is the reduction of brightness of the star images, and there is also an objection to observing stars after reflection from mercury. To overcome these difficulties, a second telescope is directed towards the first, so that the cross-wires can be seen at the centre of the field, and the sheet of glass is coated with silver to a thickness that will just allow the strongly illuminated cross-wires of the first telescope to be seen in the second. The first telescope thus serves the purpose of marking the zenith point, and this is utilised in the second telescope for the measurement of distances.

As compared with the zenith telescopes in common use, the new instrument has the advantage of greater simplicity and rigidity, and it is unnecessary to make differential measures of stars north and south of the zenith. It should especially be of use in such an investigation as that of the variation of latitude.

The Orion Nebula.—An exhaustive discussion of the photographs of this nebula, and of the stars in its vicinity, taken at Harvard and elsewhere, has been recently completed by Prof. W. H. Pickering (*Annals of the Harvard College Observatory*, vol. xxxii. part I.) 146 stars have been catalogued, in addition to those given by Bond for the same area, and a comparison of magnitudes suggests that a few of the stars are either variable or have increased in brightness. No clear indications of change in the nebula, either of shape, position, or brilliancy, have been detected in the photographs taken during the last ten years. By the ingenious arrangement of photographing the nebula through a thin perforated sheet of brass placed in contact with the sensitive film, Prof. Pickering has constructed a chart of the nebula showing isophotal contours, or lines of equal photographic intensity, which will be very valuable in subsequent searching for evidence of change. A photograph of the spectrum of the nebula taken with the objective prism shows at a glance which regions shine with light of any particular wave length. The image corresponding to the hydrogen line $H\gamma$ is seen to resemble most closely the ordinary photographs, while the ultra-violet line at λ 372 is found particularly strong along the south-east border of the Huyghenian region. Among the photographs reproduced, that showing the vast nebulosity which nearly surrounds the whole constellation of Orion is, perhaps, of the greatest interest. This was taken with a portrait lens of about 2½ inches aperture, and shows the nebulous stream, about 15 degrees in diameter, which has since been photographed by Prof. Barnard (Nature, vol. li. p. 253). Prof. Pickering gives reasons for supposing that the parallax of this remarkable nebula is not greater than $0''\cdot003$, corresponding to a distance of 1000 light-years. A useful account of the fundamental principles and processes of astronomical photography, including the determination of photographic stellar magnitudes, is given in the same volume of the *Annals*.